International Competition, Income Distribution, and North-South Uneven Development under the Balance of Payments Constraint

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Abstract

This study builds a North–South trade and growth model, and investigates the effect of a change in each country's income distribution on both countries' economic growth. The North is assumed to be a demand-led Kalecki-type economy in which the markup pricing rule and the principle of effective demand prevail, while the South is a supply-led Lewis-type economy in which surplus labor prevails and hence, the real wage is fixed. Moreover, it is assumed that the markup rate of North firms is influenced by international competition. The following four main results are obtained. First, in the short-run equilibrium, an increase in the distributive shift parameter of the North increases (decreases) the economic growth rate of the North if the North exhibits profit-led (wage-led) growth. Such an increase in the distributive shift parameter of the North also necessarily decreases the economic growth rate of the South. Second, in the short-run equilibrium, an increase in the profit share of the South decreases (increases) the economic growth rate of the North if the North exhibits profit-led (wage-led) growth. Such an increase in the profit share of the South can either increase or decrease the economic growth rate of the South. Third, in the long-run equilibrium, an increase in the distributive shift parameter of the North decreases (increases) the economic growth rates of the North and the South if the North exhibits wage-led (profit-led) growth in the short-run equilibrium. Fourth, in the long-run equilibrium, an increase in the profit share of the South increases (decreases) the economic growth rates of the North and the South if the North exhibits wage-led (profit-led) growth in the short-run equilibrium.

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1 Introduction

In this study, we focus on the relationship between income distribution and economic growth. The Kaleckian model, a type of demand-led growth model, is very useful for analyzing the relationship between income distribution and economic growth, and there have been many theoretical and empirical studies based on Kaleckian models.[1)] Many Kaleckian models are closed economy models; however, it is important to analyze distribution and growth based on open economy models, because globalization has progressed in the modern world. There are two types of open economy models: small open economy models and two-country models. In small open economy models, it is assumed that the home country is small, the price of goods is determined in the international market, and the home country has no impact on the international economy. By contrast, in two-country models, it is assumed that large countries trade with each other, economic policies in the home country have an impact on the foreign country, and there is feedback from the foreign country to the home country. In this study, to consider such feedback, we adopt a two-country model. There are two types of assumptions in two-country models, namely, that two countries are symmetric and that they are asymmetric. In this study, we analyze asymmetric countries, specifically, a developed country and a developing country. For this purpose, as a basic model, we extend Dutt (2002), which focuses on the relationship between North–South trade and the economic growth of each country, and build a model considering the effect of international competition ala Blecker (1989). Based on this model, we analyze the relationship between income distribution and growth.

For an open economy Kaleckian model, we refer to Blecker (1989). Blecker (1989) investigates a demand regime under both closed and open economies and shows that an economy is likely to be a profit-led demand regime under an open economy in which international price competition affects the economy even if is wage-led demand regime under a closed economy. An increase in the wage share decreases the price competitiveness, and accordingly, it negatively affects firms' equipment investment. Therefore, it is unlikely that a wage-led demand regime can be obtained under an open economy.

1) For representative theoretical studies based on Kaleckian models, refer to Cassetti (2003), Lima (2004), Hein (2006), Lima and Meirelles (2007), Missaglia (2007), and Sasaki (2013). For empirical studies, refer to Stockhammer and Onaran (2004), Barbosa-Filho and Taylor (2006), Naastepad and Storm (2007), Hein and Vogel (2008), Onaran and Galanis (2013), and Rezai (2015a).

Similar to the awareness of the problem that Blecker (1989) brings, Sasaki *et al.* (2013) build a small open economy Kaleckian model. The main characteristic of their model is that it endogenizes income distribution. Their results indicate that an increase in the bargaining power of firms under an open economy can decrease the capacity utilization rate even if the domestic demand regime exhibits profit-led demand, and that an increase in the bargaining power of firms under an open economy can increase the capacity utilization rate even if the domestic regime exhibits wage-led demand.

On the one hand, the abovementioned models are for a small open economy and therefore, cannot consider the feedback effect, such that a change in the income distribution of a home country affects a foreign country, and in turn, its influence rebounds on the home country. On the other hand, some studies build a two-country model and investigate how a change in income distribution in the home country affects the output and growth rates of a home country and a foreign country.

Dutt (1996) is based not on the Kaleckian model but on the classical growth model. Nevertheless, it is an interesting study that analyzes the relationship between North–South trade and economic growth. Dutt (1996) builds a model of North–South trade and economic development, and analyzes the effect of technological change in a country on the growth rates of both countries and the terms of trade. In this model, the real wage rates of both countries are exogenously given, and the goods markets in both countries are competitive. The North produces goods by inputting labor, capital, and material. North goods are in demand as consumption and investment goods and are exported to the South. South goods are produced by inputting labor and capital. South goods are in demand as consumption and investment goods, and are exported to the North. In the long run, the terms of trade are constant, and the economic growth rates of the two countries are equal. Although Dutt (1996) does not analyze the relationship between income distribution and economic growth, we can argue about it by using his model. On the one hand, when the North's real wage rate increases, the South's terms of trade in the long run decrease, and the growth rates of both countries decrease. On the other hand, when the South's real wage rate increases, the South's terms of trade in the long run increases, and the growth rates of both countries decrease. Therefore, an increase in the real wage rate in one country decreases the economic growth rates of both countries in the long-run equilibrium. In this sense, we define both the North and the South as exhibiting profit-led growth.

Nakatani (2012) and Von Arnim *et al.* (2014) present two-country Kaleckian models and examine how an increase in the home country's wage share affects the capacity utilization rates of both countries.[2)] In these studies, two countries are modeled symmetrically, that is,

2) For a two-country Kaleckian model, see also Rezai (2015b). The author's main finding is that national

two countries are essentially identical with the same demand and production structures.

By contrast, Blecker (1996) builds a two-country, North–South model and considers differences in demand and production structures of two countries. Specifically, the author models a situation in which the North produces consumption-cum-investment goods and its goods market is in imperfect competition, while the South produces consumption goods, and its goods market is in perfect competition.

Sasaki (2019) extends Dutt's (2002) model, which describes uneven development between the North and the South under North–South trade and investigates changes in income distributions on both countries' economic growth rates.[3)] In Sasaki's (2019) analysis, to capture both a wage-led growth regime and a profit-led growth regime, he uses a Marglin–Bhaduri-type investment function instead of the Kalecki-type investment function that is used in Dutt (2002). Sasaki's (2019) analysis shows how a change in the profit share affects both countries' growth rates differently for the short- and long-run equilibria. For example, in the short-run equilibrium, an increase in the North's profit share causes the South's terms of trade to deteriorate and then the South's growth rate to decrease. Meanwhile, in the long-run equilibrium, an increase in the North's profit share, through Thirlwall's law (Thirlwall, 1979; 2012), either increases or decreases the South's growth rate. Hence, the redistribution of income toward workers in the North increases both countries' growth rates if the North is a wage-led regime in both the short and long run.

Like Sasaki (2019), we analyze the relationship between income distribution and economic growth using the North–South trade model based on Dutt (2002). Dutt (2002) assumes that both countries import goods for a portion of the consumption or investment, and that the ratio of import goods depends on the relative price of domestic goods and import goods. This assumption implies that there is international price competition between the North's goods and the South's goods. However, in spite of this assumption, Dutt (2002) assumes that the North's firms always maintain a constant markup rate and do not consider the effect of international price competition on firms' pricing. Therefore, in this model, the North's economic growth rate does not depend on the terms of trade, and the change in the South's income distribution has no impact on the North's economic growth rate. However, in a real international economy, it is natural to consider that firms determine the price

policies of demand management and redistribution can have unintended macroeconomic effects.

3) Porcile and Yajima (2019) extend Dutt's (2002) model and build a model in which the North's economic growth rate is constant and the South exhibits a Kalecki-type economy. In their model, the South's investment function is a Marglin–Bhaduri type, and the South's markup rate changes according to the difference between the target profit share and real profit share. Spinola (2020) introduces a change in the technology gap between the North and the South into Dutt's (2002) model as well as wage bargaining in the South, and then analyzes a model in which the following four variables are adjusted simultaneously: the terms of trade, the South's profit share, the South's employment rate, and the technology gap between the North and the South.

of goods based on international price competition to maintain the share of domestic goods in the international market, and therefore, the assumption of the Dutt model is unrealistic. Based on this discussion, in our model, we assume that the North's markup rate depends on the terms of trade. As a result, we can describe the mechanism by which the change in income distribution and the economic growth rate in the South affect income distribution and the economic growth rate in the North through the terms of trade.

From our analysis, we obtain the following results regarding the relationship between income distribution and economic growth.

First, suppose that the distributive shift parameter of the North increases in the short-run equilibrium. This change directly increases the profit share of the North. Then, it increases the economic growth rate of the North if the North exhibits profit-led growth, while it decreases the economic growth rate of the North if the North exhibits wage-led growth. Moreover, the economic growth rate of the South unambiguously decreases.

Second, suppose that the profit share of the South, which is given exogenously, increases in the short-run equilibrium. This change decreases the profit share of the North. Then, it decreases the economic growth rate of the North if the North exhibits profit-led growth, while it increases the economic growth rate of the North if the North exhibits wage-led growth. Moreover, the economic growth rate of the South either increases or decreases.

Third, suppose that the distributive shift parameter of the North increases in the long-run equilibrium. Then, it decreases the growth rates of both the North and the South in the long-run equilibrium if the North exhibits wage-led growth in the short-run equilibrium. Meanwhile, it increases the growth rates of both the North and the South in the long-run equilibrium if the North exhibits profit-led growth in the short-run equilibrium.

Fourth, suppose that the profit share of the South increases in the long-run equilibrium. Then, it increases the growth rates of both the North and the South in the long-run equilibrium if the North exhibits wage-led growth in the short-run equilibrium. Meanwhile, it decreases the growth rates of both the North and South in the long-run equilibrium if the North exhibits profit-led growth in the short-run equilibrium.

The remainder of this paper is organized as follows. Section 2 presents the basic structure of our model. Section 3 derives the short-run equilibrium and conducts stability analysis and comparative static analysis in the short-run equilibrium. Section 4 derives the long-run equilibrium and conducts stability analysis and comparative static analysis in the long-run equilibrium. Section 5 concludes.

2 Model

North goods are produced by labor and capital stock. The production function takes the following Leontief form:

$$Y_N = \min\{E_N/b_N, u_N K_N\}, \quad b_N > 0, \tag{1}$$

where Y_N denotes the output of the North goods, E_N is employment, K_N is capital stock, b_N is the labor input coefficient, and u_N is the capacity utilization rate.[4)]

South goods are produced by employment and capital stock. The production function takes the following Leontief form:

$$Y_S = \min\{E_S/b_S, K_S/a_S\}, \quad b_S > 0,\ a_S > 0, \tag{2}$$

where Y_S denotes the output of the South goods, E_S is employment, K_S is capital stock, b_S is the labor input coefficient, and a_S is the capital input coefficient.

The price of the North goods is determined by the unit labor costs multiplied by the markup rate.

$$P_N = (1+z)W_N b_N, \quad z > 0, \tag{3}$$

where P_N denotes the price, z is the markup rate, and W_N is the nominal wage rate. The markup rate and nominal wage rate are exogenously given.

Based on related studies by Blecker (1989), Nakatani (2012), Sasaki *et al*. (2013), and Von Arnim *et al*. (2014), we assume that the markup rate of the North depends on the terms of trade.

$$z = z(P; \bar{z}), \quad \frac{\partial z}{\partial P} > 0,\ \frac{\partial z}{\partial \bar{z}} > 0, \tag{4}$$

where $P = P_S/P_N$ denotes the terms of trade, and $\bar{z}$ denotes the distributive shift parameter of the North. From equations (1) and (3), the profit share of the North is given by $\pi_N = (P_N Y_N - W_N E_N)/(P_N Y_N) = z/(1+z)$, which implies that π_N is an increasing function of z. Therefore, from equation (4), the profit share of the North is an increasing function of P and

4) Let the potential output be Y_N^F. Then, the capacity utilization rate is given by $u_N = Y_N/Y_N^F$. Suppose that the ratio of capital stock to potential output K_N/Y_N^F is constant. Then, the output–capital ratio Y_N/K_N is a proxy variable of the capacity utilization rate.

an increasing function of $\bar{z}$.

$$\pi_N = \pi_N(P; \bar{z}), \quad \frac{\partial \pi_N}{\partial P} > 0, \ \frac{\partial \pi_N}{\partial \bar{z}} > 0. \tag{5}$$

In our model, firms in the North determine the markup rate according to both international and domestic factors.

First, equation (4) states that the international factor that determines the markup rate is shown by the specification that the markup rate z is an increasing function of the terms of trade P. Firms in the North determine the price considering international competition with South goods. When the price of the South goods decreases relative to the price of the North goods, firms in the North decrease the markup rate to maintain the share in the international market. On the contrary, when the price of the South goods increases relative to the price of the North goods, firms in the North increase the markup rate, because they can maintain their share in the international market even if they raise the price of the North goods.

Second, equation (4) states that the domestic factor that determines the markup rate is shown by the specification that the markup rate z is an increasing function of the distributive shift parameter $\bar{z}$. The distributive shift parameter z represents the relative bargaining power between workers and firms in the North. It decreases when the relative bargaining power of workers is strong, whereas it increases when the relative bargaining power of firms is strong.

We assume that the South's real wage rate is constant and exogenously given.

$$\frac{W_S}{P_S} = V_S. \tag{6}$$

With equation (6), the South's profit share is given by

$$\pi_S = \frac{P_S Y_S - W_S E_S}{P_S Y_S} = 1 - b_S V_S. \tag{7}$$

Because the labor input coefficient and the real wage rate are constant, the profit share is also constant. When b_S declines by technical progress or V_S declines for some reason, the South's profit share increases.

Workers in the North spend all their wage income on consumption and, therefore, do not save at all. Capitalists in the North spend a fraction s_N of profit income on saving and the rest $1 - s_N$ on consumption. Both workers and capitalists allocate a fraction α of consumption expenditure to the purchase of the South goods and the rest $1 - \alpha$ to the purchase of the North goods. The fraction α is assumed to be

$$\alpha = \alpha_0 Y_N^{\varepsilon_N - 1} P^{1-\mu_N}, \quad P = \frac{P_S}{P_N}, \quad \alpha_0 > 0, \ \varepsilon_N > 0, \ \mu_N > 0, \tag{8}$$

where α_0 denotes a positive constant, $P = P_S/P_N$ are the South's terms of trade, ε_N is the income elasticity of the North's import demand, and μ_N is the price elasticity of the North's import demand. According to Dutt (2002), we assume that $\varepsilon_N < 1$, that is, the North expenditure coefficient for South goods decreases as North income increases, which means that the South goods are necessities.

Workers in the South spend all wage income on the purchase of South goods and therefore, do not save at all. South capitalists spend a fraction s_S of profit income on saving, a fraction β of the rest $1 - s_S$ of profit income on the purchase of the North goods, and the rest $1 - \beta$ on the purchase of South goods. The fraction β is assumed to be

$$\beta = \beta_0(\pi_S Y_S)^{\varepsilon_S - 1} P^{1-\mu_S}, \quad \beta_0 > 0,\ \varepsilon_S > 0,\ \mu_S > 0, \tag{9}$$

where β_0 denotes a positive constant, ε_S is the income elasticity of the South's import demand, and μ_S is the price elasticity of the South's import demand. According to Dutt (2002), we assume that $\varepsilon_S > 1$, that is, the South expenditure coefficient for the North goods increases as South income increases, which means that the North goods are luxury goods.

Following Marglin and Bhaduri (1990), we assume that the capital investment function in the North is an increasing function of the capacity utilization rate and profit share.

$$g_N \equiv \frac{I_N}{K_N} = \gamma_0 + \gamma_1 u_N + \gamma_2 \pi_N, \quad \gamma_0 > 0,\ \gamma_1 > 0,\ \gamma_2 > 0, \tag{10}$$

where I_N denotes investment, and $\gamma_i\,(i = 0, 1, 2)$ is a positive constant. In equation (10), because the profit rate is equal to the product of the capacity utilization rate and profit share, we assume that the capacity utilization rate and profit share differently affect firms' planned investments. Dutt (2002) assumes that the investment function is an increasing function of the capacity utilization rate, which corresponds to the case of $\gamma_2 = 0$ in equation (10).

The value of the North's imports from the South is equal to the value of the South's exports to the North, which is given by

$$P_S X_S = \alpha(1 - s_N \pi_N) P_N Y_N. \tag{11}$$

From equation (11), the volume of the South's exports is given by

$$X_S = \alpha_0(1 - s_N \pi_N) P^{-\mu_N} Y_N^{\varepsilon_N}, \tag{12}$$

The value of the South's imports from the North is equal to that of the North's exports

to the South, which is given by

$$P_N X_N = \beta \pi_S P_S Y_S. \tag{13}$$

From equation (13), the volume of the North's exports is given by

$$X_N = \beta_0 \pi_S^{\varepsilon_S} P^{\mu_S} Y_S^{\varepsilon_S}. \tag{14}$$

The excess demand for the South goods, ED_S, is given by

$$ED_S = C_{SS} + I_{SS} + X_S - Y_S, \tag{15}$$

where C_{SS} denotes the South consumption demand for the South goods; and I_{SS} is the South investment demand for the South goods. Because $Y_S = C_{SS} + I_{SS} + M_S$ and $M_S = X_N/P$ hold, equation (15) can be rewritten as

$$ED_S = X_S - (1/P)X_N. \tag{16}$$

The excess demand for North goods, ED_N, is given by

$$ED_N = C_{NN} + I_N + X_N - Y_N, \tag{17}$$

where C_{NN} denotes North consumption demand for North goods. Because $Y_N = C_{NN} + M_N + S_N$ and $M_N = PX_S$ hold, equation (17) can be rewritten as

$$ED_N = I_N - S_N + X_N - PX_S. \tag{18}$$

3 Short-run equilibrium

We define the short run as a situation in which both countries' capital stocks K_N and K_S are constant. The short-run equilibrium is achieved when $ED_S = 0$ and $ED_N = 0$. From our assumption, the North's saving is given by

$$S_N = s_N \pi_N Y_N. \tag{19}$$

Therefore, from equations (16) and (18), the terms of trade that establish $ED_S = 0$ and the capacity utilization rate that establishes $ED_N = 0$ are given by

$$P^* = \left\{ \frac{\alpha_0[1 - s_N\pi_N(P^*, \bar{z})]}{\beta_0 \pi_S^{\varepsilon_S}} \left[\frac{\gamma_0 + \gamma_2\pi_N(P^*, \bar{z})}{s_N\pi_N(P^*, \bar{z}) - \gamma_1} \cdot K_N \right]^{\varepsilon_N} \left(\frac{K_S}{a_S} \right)^{-\varepsilon_S} \right\}^{\frac{1}{\mu_N + \mu_S - 1}}, \tag{20}$$

$$u_N = \frac{\gamma_0 + \gamma_2\pi_N(P, \bar{z})}{s_N\pi_N(P, \bar{z}) - \gamma_1}. \tag{21}$$

respectively. Solving equation (20) with respect to P^*, we obtain the short-run equilibrium terms of trade. Substituting it into equation (21), we obtain u_N^*.

From our assumption, the South's saving is given by

$$S_S = s_S\pi_S Y_S = \frac{s_S\pi_S K_S}{a_S}. \tag{22}$$

Since the South's investment is composed of both the North and the South goods, we assume that the South's investment is given by

$$I_S = P^{\xi} S_S, \quad 0 < \xi < 1, \tag{23}$$

where ξ denotes a parameter that captures the effect of a change in the terms of trade on investment in the South. Substituting equation (22) into equation (23) and dividing the resultant expression by K_S, we obtain the South's growth rate.

$$g_S = \frac{s_S\pi_S}{a_S} P^{\xi}. \tag{24}$$

Therefore, the South's growth rate is an increasing function of the terms of trade.

Using P^*, we obtain the capacity utilization rate of the North, the growth rate of the North, and the growth rate of the South in the short-run equilibrium as follows:

$$u_N^* = \frac{\gamma_0 + \gamma_2\pi_N(P^*)}{s_N\pi_N(P^*) - \gamma_1}, \tag{25}$$

$$g_N^* = \frac{s_N[\gamma_0 + \gamma_2\pi_N(P^*)]\pi_N(P^*)}{s_N\pi_N(P^*) - \gamma_1}, \tag{26}$$

$$g_S^* = \frac{s_S\pi_S}{a_S}(P^*)^{\xi}, \tag{27}$$

respectively. Here, to prepare for the later analysis, we investigate the relationship between the profit share of the North π_N and the growth rate of the North g_N. From equation (26), we

take the partial derivative of g_N^* with respect to π_N.

$$\frac{\partial g_N^*}{\partial \pi_N} = \frac{s_N f(\pi_N)}{(s_N \pi_N - \gamma_1)^2}, \tag{28}$$

where

$$f(\pi_N) = s_N \gamma_2 \left(\pi_N - \frac{\gamma_1}{s_N} \right)^2 - \gamma_0 \gamma_1 - \frac{\gamma_2 \gamma_1^2}{s_N}, \tag{29}$$

$$f(0) = -\gamma_0 \gamma_1 < 0, \tag{30}$$

$$f(1) = s_N \gamma_2 - 2\gamma_1 \gamma_2 - \gamma_0 \gamma_1. \tag{31}$$

Here, we introduce the following definition.

Definition 1. *In the short-run equilibrium, we define $\partial g_N^*/\partial \pi_N < 0$ as wage-led growth in the short-run equilibrium, whereas $\partial g_N^*/\partial \pi_N > 0$ is profit-led growth.*

With the Keynesian stability condition given by $s_N \pi_N - \gamma_1 > 0$, we should consider the domain of the profit share $\pi_N \in (\gamma_1/s_N, 1)$. The sign of $\partial g_N^*/\partial \pi_N$ is equal to that of $f(\pi_N)$. Hence, we should investigate the sign of $f(\pi_N)$.

When $f(1) < 0$, we always have $f(\pi_N) < 0$ for $\pi_N \in (\gamma_1/s_N, 1)$. Therefore, when $f(1) < 0$, the economy exhibits wage-led growth. On the other hand, when $f(1) > 0$, we define π_N^c as the profit share such that $f(\pi_N^c) = 0$. Then, we have $f(\pi_N) < 0$ for $\pi_N \in (\gamma_1/s_N, \pi_N^c)$ while $f(\pi_N) > 0$ for $\pi_N \in (\pi_N^c, 1)$. Therefore, the economy exhibits wage-led growth for $\pi_N \in (\gamma_1/s_N, \pi_N^c)$, but profit-led growth for $\pi_N \in (\pi_N^c, 1)$. In summary, we obtain the following proposition.

Proposition 1. *When $s_N \gamma_2 - 2\gamma_1 \gamma_2 - \gamma_0 \gamma_1 < 0$, the North exhibits wage-led growth. When $s_N \gamma_2 - 2\gamma_1 \gamma_2 - \gamma_0 \gamma_1 > 0$, the North exhibits wage-led growth for $\pi_N \in (\gamma_1/s_N, \pi_N^c)$, while it exhibits profit-led growth for $\pi_N \in (\pi_N^c, 1)$.*

3.1 Stability analysis of short-run equilibrium

In this subsection, we examine the stability of the short-run equilibrium. The system of differential equations in the short run leads to

$$\dot{P} = \psi \left\{ \alpha_0 [1 - s_N \pi_N(P)] P^{-\mu_N} (u_N K_N)^{\varepsilon_N} - \beta_0 \pi_S^{\varepsilon_S} P^{\mu_S - 1} \left(\frac{K_S}{a_S} \right)^{\varepsilon_S} \right\}, \tag{32}$$

$$\dot{u}_N = \phi \left[\gamma_0 + \gamma_1 u_N + \gamma_2 \pi_N(P) - s_N \pi_N(P) u_N - \frac{P}{\psi} \cdot \frac{\dot{P}}{K_N} \right]. \tag{33}$$

Each element of the Jacobian matrix $\mathbf{J}$ that corresponds to the system of differential equations (32) and (33) is given by

$$J_{11} = \frac{\partial \dot{P}}{\partial P} = -\psi\alpha_0(u_N K_N)^{\varepsilon_N} P^{-\mu_N} \left\{ s_N \frac{\partial \pi_N}{\partial P} + (\mu_N + \mu_S - 1)[1 - s_N\pi_N(P)]P^{-1} \right\}, \tag{34}$$

$$J_{12} = \frac{\partial \dot{P}}{\partial u_N} = \psi\{\varepsilon_N\alpha_0[1 - s_N\pi_N(P)]P^{-\mu_N} u_N^{\varepsilon_N - 1} K_N^{\varepsilon_N}\} > 0, \tag{35}$$

$$J_{21} = \frac{\partial \dot{u}_N}{\partial P} = \phi \left[\gamma_2 \frac{\partial \pi_N}{\partial P} - s_N u_N \frac{\partial \pi_N}{\partial P} - \frac{P}{\psi K_N} \cdot J_{11} \right], \tag{36}$$

$$J_{22} = \frac{\partial \dot{u}_N}{\partial u_N} = \phi \left[\gamma_1 - s_N\pi_N(P) - \frac{P}{\psi K_N} \cdot J_{12} \right] < 0. \tag{37}$$

Equations (34)–(37) are evaluated using the steady-state equilibrium values. The necessary and sufficient conditions for the short-run equilibrium to be locally stable are that the trace of $\mathbf{J}$ is negative ($\operatorname{tr}\mathbf{J} < 0$) and that the determinant of $\mathbf{J}$ is positive ($\det\mathbf{J} > 0$). If the Marshall–Lerner condition (i.e., $\mu_N + \mu_S > 1$) is satisfied, we obtain $J_{11} < 0$. In this case, we obtain $\operatorname{tr}\mathbf{J} < 0$. The determinant is given by

$$\det\mathbf{J} = \phi \left\{ J_{11}[\gamma_1 - s_N\pi_N(P)] - J_{12}(\gamma_2 - s_N u_N) \frac{\partial \pi_N}{\partial P} \right\}. \tag{38}$$

If the Keynesian stability condition $s_N\pi_N(P) - \gamma_1 > 0$ is satisfied and in addition, the condition $s_N u_N - \gamma_2 > 0$ is satisfied, we obtain $\det\mathbf{J} > 0$. The second condition means that the effect of an increase in the profit share on saving is larger than the effect of an increase in the profit share on investment. This condition is necessarily satisfied when the linear Margin–Bhaduri investment function is imposed because

$$s_N u_N^* - \gamma_2 = s_N \frac{\gamma_0 + \gamma_2\pi_N(P^*)}{s_N\pi_N(P^*) - \gamma_1} - \gamma_2 = \frac{s_N\gamma_0 + \gamma_1\gamma_2}{s_N\pi_N(P^*) - \gamma_1} > 0. \tag{39}$$

From this analysis, we obtain the following proposition regarding the stability of the short-run equilibrium.

Proposition 2. *Suppose that both the Keynesian stability condition and the Marshall–Lerner condition are satisfied. Then, the short-run equilibrium is locally asymptotically stable.*

We show the phase diagram in Figure 1. From equations (32) and (33), the locus of $\dot{u}_N = 0$ and that of $\dot{P} = 0$ are given by

$$\dot{u}_N = 0 \Longrightarrow u_N = \frac{\gamma_0 + \gamma_2\pi_N(P)}{s_N\pi_N(P) - \gamma_1}, \tag{40}$$

$$\dot{P} = 0 \Longrightarrow u_N = \frac{\beta_0 \pi_S^{\varepsilon_S} \left(\frac{K_S}{a_S}\right)^{\varepsilon_S}}{\alpha_0 K_N^{\varepsilon_N}} \cdot \frac{P^{\mu_N + \mu_S - 1}}{1 - s_N \pi_N(P)}. \tag{41}$$

On the (P, u_N) plane, the locus of $\dot{u}_N = 0$ is a downward-sloping curve and that of $\dot{P} = 0$ is an upward-sloping curve. From this, the phase diagram is shown (see Figure 1). Therefore, the short-run equilibrium is not only locally stable but also globally stable.

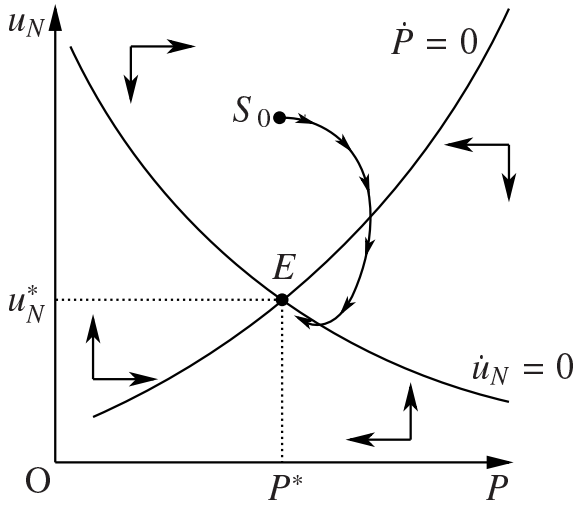

Figure 1: Phase diagram in short-run period

3.2 Comparative static analysis of short-run equilibrium

In this subsection, we conduct a comparative static analysis by assuming that the short-run equilibrium is stable.[5)] In the following, we totally differentiate equation (20) to investigate how the two parameters $\bar{z}$ and π_S affect P^*.

The effect of an increase in $\bar{z}$ on the terms of trade P^* is given by

$$\frac{dP^*}{d\bar{z}} = \frac{\Omega\Theta \frac{\partial \pi_N}{\partial \bar{z}}}{\frac{1}{P^*} - \Omega\Theta \frac{\partial \pi_N}{\partial P}} < 0. \tag{42}$$

Here, the two parameters are defined as follows:

$$\Omega \equiv \frac{1}{\mu_N + \mu_S - 1} > 0, \tag{43}$$

$$\Theta \equiv -\frac{s_N}{1 - s_N \pi_N} - \frac{\varepsilon_N(\gamma_1\gamma_2 + s_N\gamma_0)}{(\gamma_0 + \gamma_2\pi_N)(s_N\pi_N - \gamma_1)} < 0. \tag{44}$$

5) For the comparative static analysis with respect to the real wage rate of the North, see the Appendix.

The denominator and the numerator of equation (42) are positive and negative, respectively.

The effect of an increase in $\bar{z}$ on the profit share of the North π_N is given by

$$\frac{d\pi_N^*}{d\bar{z}} = \frac{\partial \pi_N}{\partial \bar{z}} \cdot \frac{1}{1 - \Omega\Theta P^* \frac{\partial \pi_N}{\partial P}} > 0. \tag{45}$$

Combining the above results with Proposition 1, we obtain the following results:

$$\bar{z} \uparrow \Longrightarrow \pi_N^* \uparrow,\ u_N^* \downarrow,\ g_N^* \uparrow \text{ or } \downarrow,\ P^* \downarrow,\ g_S^* \downarrow \tag{46}$$

The implications of the results of the comparative static analysis given by equation (46) are as follows.

When the relative bargaining power of workers in the North decreases, firms in the North raise the markup rate to increase their profits, and hence, the profit share of the North π_N^* increases. A decrease in the wage share decreases the consumption demand in the North, which lowers the capacity utilization rate u_N^*. The decrease in the capacity utilization rate decreases investment demand in the North, which has a negative effect on the economic growth rate g_N^*. However, if the positive effect of the increase in the profit share on investment demand is sufficiently large, the economic growth rate g_N^* can increase. In addition, the price of the North goods P_N increases due to the increase in the markup rate, the price of the South goods P_S decreases because the decrease in the North's consumption demand decreases the value of imports from the South, and hence, the terms of trade P^* decrease. The deterioration in the terms of trade decreases the capital accumulation rate of the South, and hence, lowers the economic growth rate of the South g_S^*.

When the relative bargaining power of workers in the North increases and, hence, the distributive shift parameter $\bar{z}$ decreases, the opposite scenario to that just described holds.

Next, the effect of an increase in the profit share of the South is given by

$$\frac{dP^*}{d\pi_S} = -\frac{\frac{\varepsilon_S}{\pi_S}\Omega}{\frac{1}{P^*} - \Omega\Theta \frac{\partial \pi_N}{\partial P}} < 0. \tag{47}$$

From equation (27), the effect of an increase in the profit share of the South π_S on the growth rate of the South is given by

$$\frac{dg_S^*}{d\pi_S} = \frac{s_S}{a_S} (P^*)^{\xi - 1} \cdot \frac{1 - \Omega\xi\varepsilon_S - \Omega\Theta P^* \frac{\partial \pi_N}{\partial P}}{\frac{1}{P^*} - \Omega\Theta \frac{\partial \pi_N}{\partial P}}. \tag{48}$$

When a change in the terms of trade does not affect the profit share of the North, that is,

$\partial\pi_N/\partial P = 0$, the sign of equation (48) is determined by the sign of the following equation.

$$1 - \Omega\xi\varepsilon_S = \frac{\mu_N + \mu_S - 1 - \xi\varepsilon_S}{\mu_N + \mu_S - 1}. \tag{49}$$

If the Marshall–Lerner condition is satisfied, the denominator of equation (49) is positive, but the numerator can be positive or negative.

On the contrary, when a change in the terms of trade affects the profit share of the North, that is, $\partial\pi_N/\partial P > 0$, the sign of equation (48) is determined by the sign of the following equation.

$$1 - \Omega\xi\varepsilon_S - \Omega\Theta P^* \frac{\partial\pi_N}{\partial P}. \tag{50}$$

Because the third term on the right-hand side of equation (50) is positive, equation (50) is likely to be positive compared to equation (49), but it can be negative depending on the conditions.

Combining the above results and Proposition 1, we obtain the following results:

$$\pi_S \uparrow \Longrightarrow \pi_N^* \downarrow,\ u_N^* \uparrow,\ g_N^* \uparrow \text{ or } \downarrow,\ P^* \downarrow,\ g_S^* \uparrow \text{ or } \downarrow \tag{51}$$

The following explanation can be given for the effect of an increase in the profit share of the South π_S on the economic growth rate of the South g_S^* when a change in the terms of trade does not affect the profit share of the North.

On the one hand, an increase in the profit share of the South π_S fosters capital accumulation and hence, has a positive effect on the economic growth rate of the South. On the other hand, an increase in the economic growth rate of the South increases the value of imports from the North, which leads to an increase in the price of the North goods and a decrease in the terms of trade P^*. The deterioration of the terms of trade has a negative effect on capital accumulation, and hence, it offsets the abovementioned growth-enhancing effect. When the absolute value of $\xi\varepsilon_S$ is sufficiently large (i.e., the positive effect of an increase in the South income on the value of the South's imports from the North is sufficiently large), then the negative effect of the deterioration of the terms of trade dominates the positive effect of an increase in the profit share. Consequently, the pace of capital accumulation decreases, which lowers the economic growth rate of the South g_S^*. In this case, the South exhibits wage-led growth. On the contrary, when the absolute value of $\xi\varepsilon_S$ is sufficiently small (i.e., the positive effect of an increase in the South income on the value of the South's imports from the North is not so large), then the positive effect of an increase in the profit share dominates the negative effect of the deterioration of the terms of trade. Hence, the economic growth rate

of the South g_S^* increases. In this case, the South exhibits profit-led growth.

Next, the implication for the result of the comparative static analysis when the terms of trade affect the profit share of the North is as follows.

When the right-hand side of equation (49) is negative (i.e., even when the South exhibits wage-led growth under the condition that the terms of trade do not affect the profit share of the North), then the South can exhibit profit-led growth because the right-hand side of equation (48) is positive if the absolute value of the third term on the right-hand side of equation (50) is sufficiently large. This is because the markup rate of the North decreases according to the terms of trade P^*, and hence, the profit share of the North π_N decreases, which increases the consumption demand of the North and imports from the South. When the value of exports from the South to the North increases, the price of the South goods increases, the terms of trade improve to some extent, and the negative effect of a decrease in the terms of trade on capital accumulation of the South diminishes. The third term on the right-hand side of equation (50) shows the opposite effect, such that the effect of this change in the terms of trade on capital accumulation in the South occurs through the profit share of the North. Then, if this effect is sufficiently large, the decrease in the economic growth effect of the South through the deterioration of the terms of trade can be diminished.

We conduct a comparative static analysis with respect to the saving rate of the South s_S. To start, since s_S does not appear in equation (20), which determines the short-run equilibrium terms of trade, s_S does not affect P^*. From this, s_S does not affect π_N^*. Accordingly, s_S does not affect u_N^* and g_N^*. By contrast, s_S appears in equation (27), which shows that g_S^*, and hence, an increase in s_S increases g_S^*.

$$s_S \uparrow \Longrightarrow P^*-,\ \pi_N^*-,\ u_N^*-,\ g_N^*-,\ g_S^* \uparrow \tag{52}$$

These results can be explained as follows.

In the South, workers consume only domestic goods, and capitalists buy a constant fraction of consumption goods and investment goods by importing from the South. Hence, a change in the capitalists' saving rate s_S does not affect the value of imports from the North. Accordingly, the terms of trade do not change and the profit share of the North π_N^*, the capacity utilization rate of the North u_N^*, and the economic growth rate of the North g_N^* do not change. Meanwhile, in the South, an increase in the saving of the South directly increases the investment in the South. Therefore, an increase in the saving rate s_S necessarily increases the economic growth rate of the South g_S^*.

We conduct a comparative static analysis with respect to the saving rate of the North s_N. From equation (20), the effect of an increase in the saving rate of the North on the terms of

trade in the South is as follows.

$$\frac{dP^*}{ds_N} = -\frac{\Omega\Gamma\pi_N(P^*)}{\frac{1}{P^*} - \Omega\Theta\frac{\partial\pi_N}{\partial P}} < 0, \quad \Gamma = \frac{1}{1 - s_N\pi_N(P^*)} + \frac{\varepsilon_N}{s_N\pi_N(P^*) - \gamma_1} > 0. \tag{53}$$

An increase in s_N decreases the South's terms of trade, which decreases the economic growth rate of the South. By assumption, a decrease in the South's terms of trade decreases the profit share of the North. Based on this result, from equation (25), the effect of an increase in the saving rate of the North on the capacity utilization rate of the North is given by

$$\frac{d\log u_N^*}{ds_N} = -\frac{\pi_N(P^*)}{s_N\pi_N(P^*) - \gamma_1} - \frac{\gamma_1\gamma_2 + s_N\gamma_0}{[\gamma_0 + \gamma_2\pi_N(P^*)][s_N\pi_N(P^*) - \gamma_1]}\frac{d\pi_N^*}{ds_N} \gtreqless 0. \tag{54}$$

This can be positive or negative. In the closed economy Kaleckian model, an increase in the saving rate decreases the capacity utilization rate. However, in the open economy Kaleckian model, an increase in the saving rate can increase the capacity utilization rate. From equation (26), the effect of an increase in the saving rate of the North on the economic growth rate of the North is as follows.

$$\frac{d\log g_N^*}{ds_N} = -\frac{\gamma_1}{s_N[s_N\pi_N(P^*) - \gamma_1]} + \frac{f(\pi_N^*)}{\Lambda}\frac{d\pi_N^*}{ds_N}, \tag{55}$$

where

$$\Lambda \equiv \pi_N(\gamma_0 + \gamma_2\pi_N)(s_N\pi_N - \gamma_1) > 0. \tag{56}$$

When the short-run equilibrium exhibits profit-led growth, we have $f(\pi_N^*) > 0$, and hence, equation (54) is negative. When the short-run equilibrium exhibits wage-led growth, we have $f(\pi_N^*) < 0$, and hence, equation (54) can be positive or negative. When the North exhibits profit-led growth, the paradox of thrift holds. When the North exhibits wage-led growth, the opposite of the paradox of thrift holds.

$$s_N \uparrow \Longrightarrow P^* \downarrow,\ \pi_N^* \downarrow,\ u_N^* \uparrow \text{ or } \downarrow,\ g_N^* \uparrow \text{ or } \downarrow,\ g_S^* \downarrow \tag{57}$$

The effect of an increase in the saving rate of the North on the equilibrium values can be explained as follows. An increase in s_N decreases consumption demand in the North and hence, decreases the capacity utilization rate u_N^*. The decrease in consumption decreases the value of imports from the South, and hence, decreases the terms of trade P^*. This deterioration of the terms of trade decreases the capital accumulation rate of the South,

which lowers the economic growth rate of the South g_S^*.

In the North, when the terms of trade P^* decrease, firms in the North lower the markup rate z, which decreases the profit share of the North π_N^*. When this decrease in π_N^* is sufficiently large, even if s_N increases, the consumption expenditure share of the North $1 - s_N\pi_N$ increases, the consumption demand of the North increases, and hence, the capacity utilization rate of the North u_N^* increases. On the contrary, when this decrease in π_N^* is sufficiently small, an increase in the saving rate of the North s_N decreases the capacity utilization rate of the North u_N^*.

Next, we consider the effect of an increase in the saving rate s_N on the economic growth rate of the North g_N^*. An increase in s_N decreases consumption demand and investment demand, which has a negative effect on capital accumulation. This negative effect is shown by the first term on the right-hand side of equation (54). As stated above, since an increase in the saving rate of the North s_N decreases the profit share of the North π_N^*, it also has a negative effect on g_N^* if the North exhibits profit-led growth in the short-run equilibrium. This negative effect is shown by the second term on the right-hand side of equation (54). Therefore, when the North exhibits profit-led growth in the short-run equilibrium, an increase in the saving rate of the North s_N necessarily decreases the economic growth rate of the North g_N^*. On the contrary, when the North exhibits wage-led growth in the short-run equilibrium and, in addition, the negative effect of an increase in s_N on the profit share of the North π_N^* is sufficiently strong, then an increase in consumption demand increases the economic growth rate of the North g_N^*. In this case, the paradox of thrift does not hold.

From this analysis, the results of the comparative static analysis for the short-run equilibrium are summarized in Table 1.

Table 1: Results of comparative statics of the short-run equilibrium

	P^*	π_N^*	u_N^*	g_N^*	g_S^*
$\bar{z}$	$-$	$+$	$-$	$-^{\dagger}\quad +^{\ddagger}$	$-$
π_S	$-$	$-$	$+$	$+^{\dagger}\quad -^{\ddagger}$	$+/-$
s_N	$-$	$-$	$+/-$	$+/-^{\dagger}\quad -^{\ddagger}$	$-$
s_S	0	0	0	0	$+$

† Short-run equilibrium exhibits a wage-led growth regime.

‡ Short-run equilibrium exhibits a profit-led growth regime.

Consequently, for the relationship between income distribution and growth in the short-

run equilibrium, we obtain the following two propositions.

Proposition 3. *Suppose that the distributive shift parameter of the North increases in the short-run equilibrium. Then, it increases the economic growth rate of the North if the North exhibits profit-led growth, while it decreases the growth rate of the North if the North exhibits wage-led growth. Moreover, the economic growth rate of the South decreases.*

Proposition 4. *Suppose that the profit share of the South increases in the short-run equilibrium. Then, the profit share of the North decreases, which decreases the economic growth rate of the North if the North exhibits profit-led growth, while it increases the economic growth rate of the North if the North exhibits wage-led growth. Moreover, the economic growth rate of the South either increases or decreases.*

4 Long-run equilibrium

We define the long run as a situation in which the short-run equilibrium always holds and capital accumulation in each country proceeds owing to capital investment. In other words, K_N and K_S evolve in the long run. In this case, the short-run equilibrium value of the terms of trade P^* also evolves. We define a long-run equilibrium as a situation in which $\dot{P}^* = 0$.[6)]

The long-run equilibrium is a situation in which $\dot{P}^* = 0$ holds. Taking the natural logarithm of the short-run equilibrium condition given by equation (20) and differentiating the resultant expression with respect to time, we obtain

$$\frac{\dot{P}^*}{P^*} = \frac{1}{\mu_N + \mu_S - 1}\left\{\frac{-s_N \frac{\partial \pi_N}{\partial P}}{1 - s_N \pi_N(P^*)}\dot{P}^* + \varepsilon_N\left[\frac{\gamma_2 \frac{\partial \pi_N}{\partial P}}{\gamma_0 + \gamma_2 \pi_N(P^*)}\dot{P}^* - \frac{s_N \frac{\partial \pi_N}{\partial P}}{s_N \pi_N(P^*) - \gamma_1}\dot{P}^* + \frac{s_N[\gamma_0 + \gamma_2 \pi_N(P^*)]\pi_N(P^*)}{s_N \pi_N(P^*) - \gamma_1}\right] - \varepsilon_S \frac{s_S \pi_S}{a_S}(P^*)^{\xi}\right\}. \quad (58)$$

Using $\dot{P}^* = 0$, we find that the long-run equilibrium terms of trade P^{**} satisfy the following equation:

$$\varepsilon_S g_S(P^{**}) - \varepsilon_N g_N(P^{**}) = 0. \quad (59)$$

Specifically, from equations (26), (27), and (59), the long-run equilibrium terms of trade P^{**}

6) In many two-country growth models, as Dutt (2002) also states, the long-run equilibrium is assumed to be a situation in which both countries grow at the same rate and the capital stock ratio K_N/K_S is constant. However, in our model and that of Dutt, the terms of trade continue to decrease when both countries grow at the same rate, and this situation cannot be the long-run equilibrium.

satisfy the following equation:

$$P^{**} = \left\{ \frac{\varepsilon_N}{\varepsilon_S} \cdot \frac{a_S}{s_S \pi_S} \cdot \frac{s_N[\gamma_0 + \gamma_2 \pi_N(P^{**}, \bar{z})]\pi_N(P^{**}, \bar{z})}{s_N \pi_N(P^{**}, \bar{z}) - \gamma_1} \right\}^{\frac{1}{\xi}}. \tag{60}$$

From this, we find that in the long run, Thirlwall's law holds as follows:

$$g_S^{**} = \frac{\varepsilon_N}{\varepsilon_S} g_N^{**} \Longrightarrow \frac{g_S^{**}}{g_N^{**}} = \frac{\varepsilon_N}{\varepsilon_S} < 1. \tag{61}$$

4.1 Stability analysis of long-run equilibrium

In this subsection, we examine the stability of the long-run equilibrium. Equation (58) can be arranged as follows:

$$\dot{P} = \Omega \frac{B(P)}{A(P)}, \tag{62}$$

where

$$A(P) \equiv \frac{1}{P} + \Omega \varepsilon_N \frac{\partial \pi_N}{\partial P} \frac{\gamma_1 \gamma_2 + s_N \gamma_0}{[\gamma_0 + \gamma_2 \pi_N(P)][s_N \pi_N(P) - \gamma_1]} + \Omega \frac{s_N \frac{\partial \pi_N}{\partial P}}{1 - s_N \pi_N(P)} > 0, \tag{63}$$

$$B(P) \equiv \varepsilon_N g_N(P) - \varepsilon_S g_S(P) = \varepsilon_N \frac{s_N[\gamma_0 + \gamma_2 \pi_N(P)]\pi_N(P)}{s_N \pi_N(P) - \gamma_1} - \varepsilon_S \frac{s_S \pi_S}{a_S} P^{\xi}. \tag{64}$$

The necessary and sufficient condition for the long-run equilibrium to be stable is that the derivative of $\dot{P}$ with respect to P is negative when it is evaluated at $P = P^{**}$. From equation (62), we obtain

$$\begin{aligned} \left. \frac{d\dot{P}}{dP} \right|_{P=P^{**}} &= \Omega \frac{B'(P^{**})A(P^{**}) - B(P^{**})A'(P^{**})}{A(P^{**})^2} \\ &= \Omega \frac{B'(P^{**})A(P^{**})}{A(P^{**})^2} \\ &= \Omega \frac{B'(P^{**})}{A(P^{**})}, \end{aligned} \tag{65}$$

where we use the fact that at the long-run equilibrium, $B(P^{**}) = 0$ from equation (64). From equation (63), we have $A(P) > 0$. Accordingly, if $B'(P) < 0$, the long-run equilibrium is locally stable. From equation (64), $B'(P) < 0$ can be calculated as follows:

$$B'(P) = \varepsilon_N s_N \frac{f(\pi_N(P)) \frac{\partial \pi_N}{\partial P}}{[s_N \pi_N(P) - \gamma_1]^2} - \frac{\xi \varepsilon_S s_S \pi_S}{a_S} P^{\xi - 1}. \tag{66}$$

When the short-run equilibrium exhibits wage-led growth, that is, $f(\pi_N) < 0$, we obtain $B'(P) < 0$. Therefore, the long-run equilibrium is locally stable.

When the short-run equilibrium exhibits profit-led growth, that is, $f(\pi_N) > 0$, we have $B'(P) < 0$ if the following condition holds.

$$\varepsilon_N s_N \frac{f(\pi_N(P)) \frac{\partial \pi_N}{\partial P}}{[s_N \pi_N(P) - \gamma_1]^2} < \frac{\xi \varepsilon_S s_S \pi_S}{a_S} P^{\xi - 1}. \tag{67}$$

Rearranging the condition given by equation (67), we obtain

$$\frac{\xi}{P^{**}} - \frac{f(\pi_N(P^{**})) \frac{\partial \pi_N}{\partial P}}{\Lambda} > 0. \tag{68}$$

Accordingly, we obtain the following two propositions.

Proposition 5. *Suppose that the short-run equilibrium exhibits wage-led growth. Then, the long-run equilibrium is locally asymptotically stable.*

Proposition 6. *Suppose that the short-run equilibrium exhibits profit-led growth. Then, the long-run equilibrium is locally asymptotically stable as long as* $\xi / P^{**} > f(\pi_N(P^{**}))\, \partial \pi_N / \partial P / \Lambda$.

The implication for the long-run stability condition given by equation (68) can be explained as follows. When $f(\pi_N) < 0$, that is, the North exhibits wage-led growth, the stability condition always holds. This is explained by the following mechanism.

Suppose that the terms of trade P deviate from the long-run value P^{**} for some reason. Then, on the one hand, firms in the North lower the markup rate z, which decreases the profit share of the North π_N. Since the North exhibits wage-led growth, the economic growth rate of the North g_N increases, which increases the growth rate of consumption demand of the North, increasing the growth rate of the value of the North's imports from the South. On the other hand, in the South, the decrease in the terms of trade P reduces the capital accumulation rate, and hence, decreases the economic growth rate of the South g_S. This lowers the growth rate of the value of the South's imports from the North. Since the value of the South's exports to the North increases and the value of the North's exports to the South decreases, the terms of trade P increase, and again, converge to the long-run equilibrium P^{**}.

Suppose that the North exhibits profit-led growth when $f(\pi_N) > 0$. Here, suppose that the effect of a change in the terms of trade P on the economic growth rate of g_N is larger than the effect of a change in the terms of trade P on the economic growth rate of g_S. In other words, the investment elasticity with respect to the terms of trade ξ is small, and the effects of the terms of trade on the economic growth rate of the North g_N through z and π_N (i.e.,

$f(\pi_N(P^{**}))\,\partial\pi_N/\partial P)$ is sufficiently large. Then, we have $\xi/P^{**} < f(\pi_N(P^{**}))\,\partial\pi_N/\partial P/\Lambda$, the stability condition does not hold, and hence, the long-run equilibrium is unstable. This can be explained as follows.

Suppose that the terms of trade P deviate from the long-run equilibrium value P^{**} for some reason. Then, firms in the North lower the markup rate, and hence, the profit share of the North decreases. Since the North exhibits profit-led growth, the growth rate of the North g_N decreases, which lowers the growth rate of consumption demand of the North, decreasing the growth rate of the value of the North's imports from the South. On the other hand, in the South, the decrease in the terms of trade P lowers the capital accumulation rate and the economic growth rate g_S, which decreases the growth rate of the value of the South's imports from the North. However, the extent of the decrease in imports is less than the extent of the decrease in the growth rate of the value of the North's imports from the South. As a result, the terms of trade further decrease, and hence, it further deviates from P^{**}.

Even if the North exhibits profit-led growth, the long-run equilibrium is stable if the effect of a change in the terms of trade on the economic growth rate g_S dominates the effect of a change in the terms of trade on the economic growth rate g_N, that is, $\xi/P^{**} > f(\pi_N(P^{**}))\,\partial\pi_N/\partial P/\Lambda$ holds. This is because the economic growth rate of the South decreases more than the economic growth rate of the North when P decreases from P^{**}, and P again converges to P^{**} because the value of imports from the North to the South.

Figures 2 and 3 show the relationship between P^* and the economic growth rate g_i. The horizontal and vertical axes correspond to the short-run equilibrium terms of trade and the short-run equilibrium growth rate of each country, respectively. The growth rate of the South is increasing in the terms of trade. The growth rate of the North is decreasing in the terms of trade when the short-run equilibrium exhibits wage-led growth but increasing in the terms of trade when the short-run equilibrium exhibits profit-led growth. Because $\varepsilon_S > 1$ and $\varepsilon_N < 1$, the curve $\varepsilon_S g_S$ is located above the curve g_S, whereas the curve $\varepsilon_N g_N$ is located below the curve g_N. The intersection of the curves $\varepsilon_S g_S$ and $\varepsilon_N g_N$ gives the long-run equilibrium. From these figures, we observe that the long-run equilibrium is globally stable as well as locally stable. Moreover, from these figures, we can observe that even if $g_S^* > g_N^*$ holds in the short run, $g_S^{**} < g_N^{**}$ holds in the long run, and hence, the South cannot catch up with the North in the long run.

4.2 Comparative static analysis of long-run equilibrium

We conduct a comparative static analysis by assuming that the long-run equilibrium is stable. By totally differentiating equation (60), we investigate the effects of changes in the two parameters $\bar{z}$ and π_S on P^{**}.

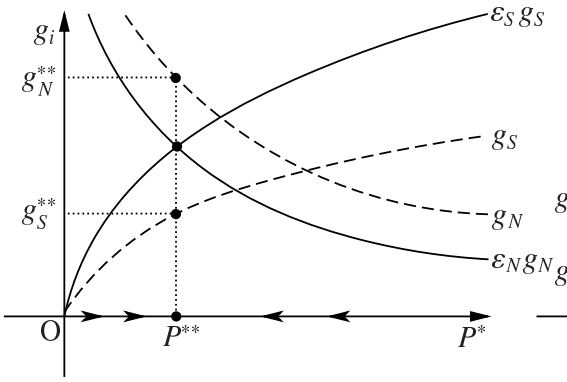

Figure 2: Relationship between terms of trade and economic growth when short-run growth is wage led

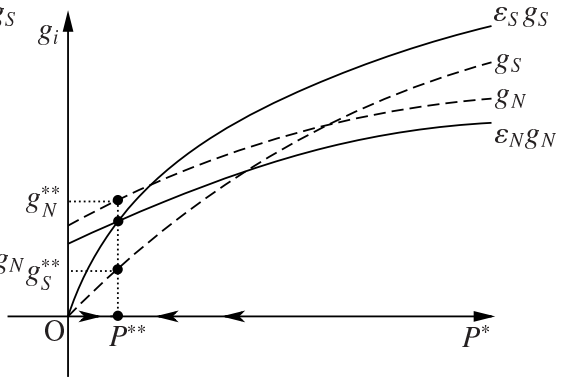

Figure 3: Relationship between terms of trade and economic growth when short-run growth is profit led

The effect of an increase in $\bar{z}$ on P^{**} is as follows:

$$\frac{dP^{**}}{d\bar{z}} = \frac{\frac{f(\pi_N)}{\Lambda} \cdot \frac{\partial \pi_N}{\partial \bar{z}}}{\frac{\xi}{P^{**}} - \frac{f(\pi_N)}{\Lambda} \cdot \frac{\partial \pi_N}{\partial P}}. \tag{69}$$

When $f(\pi_N) < 0$, that is, the short-run equilibrium exhibits wage-led growth, the sign of equation (69) is negative. When $f(\pi_N) > 0$, that is, the short-run equilibrium exhibits profit-led growth, the sign of equation (69) is positive.

The effect of an increase in $\bar{z}$ on π_N^{**} is as follows:

$$\frac{d\pi_N^{**}}{d\bar{z}} = \frac{\partial \pi_N}{\partial \bar{z}} \left[\frac{\frac{\xi}{P^{**}}}{\frac{\xi}{P^{**}} - \frac{f(\pi_N)}{\Lambda} \frac{\partial \pi_N}{\partial P}} \right]. \tag{70}$$

When $f(\pi_N) < 0$, that is, the short-run equilibrium exhibits wage-led growth, the sign of equation (70) is positive. When $f(\pi_N) > 0$, that is, the short-run equilibrium exhibits profit-led growth, the sign of equation (70) is ambiguous.

The effect of an increase in the profit share of the South π_S on P^{**} is as follows:

$$\frac{dP^{**}}{d\pi_S} = -\frac{\frac{1}{\pi_S}}{\frac{\xi}{P^{**}} - \frac{f(\pi_N)}{\Lambda} \cdot \frac{\partial \pi_N}{\partial P}}. \tag{71}$$

When the short-run equilibrium exhibits wage-led growth, the sign of equation (71) is negative.

From the above analysis, the results of the long-run comparative static analysis are as follows.

First, when the short-run equilibrium exhibits wage-led growth, the results are as follows.

$$\bar{z}\uparrow \Longrightarrow P^{**}\downarrow,\ \pi_N^{**}\uparrow,\ u_N^{**}\downarrow,\ g_N^{**}\downarrow,\ g_S^{**}\downarrow \tag{72}$$

$$\pi_S\uparrow \Longrightarrow P^{**}\downarrow,\ \pi_N^{**}\downarrow,\ u_N^{**}\uparrow,\ g_N^{**}\uparrow,\ g_S^{**}\uparrow \tag{73}$$

Second, when the short-run equilibrium exhibits profit-led growth, the results are as follows.

$$\bar{z}\uparrow \Longrightarrow P^{**}\uparrow,\ \pi_N^{**}\uparrow,\ u_N^{**}\downarrow,\ g_N^{**}\uparrow,\ g_S^{**}\uparrow \tag{74}$$

$$\pi_S\uparrow \Longrightarrow P^{**}\downarrow,\ \pi_N^{**}\downarrow,\ u_N^{**}\uparrow,\ g_N^{**}\downarrow,\ g_S^{**}\downarrow \tag{75}$$

We investigate the effect of an increase in the distributive shift parameter $\bar{z}$ on the long-run equilibrium values.

The implications for the results given by equation (72) are as follows.

When $\bar{z}$ increases, the price of the North goods P_N increases, which lowers the terms of trade P^* in the short-run equilibrium. In this case, the profit share of the North π_N^* increases, and hence the capacity utilization rate u_N^* decreases, which decreases the economic growth rate of the North g_N^* when the short-run equilibrium exhibits wage-led growth. As a result, the growth rate of the consumption of the North also decreases, and hence, the growth rate of the value of the North's imports from the South decreases too, which further reduces the terms of trade P^* in the long run. Therefore, when the short-run equilibrium exhibits wage-led growth, an increase in the distributive shift parameter $\bar{z}$ in the long run lowers the terms of trade P^{**}, increases the profit share of the North π_N^{**}, decreases the capacity utilization rate of the North u_N^{**}, and decreases the economic growth rate of the North g_N^{**}. In the same case in the South, the capital accumulation decreases because of the decrease in the terms of trade P^{**}. In addition, the growth rate of the South's exports to the North decreases, and consequently, the growth rate of the South g_S^{**} decreases.

Next, we consider the case in which with respect to equation (74), the North exhibits profit-led growth in the short-run equilibrium, and the denominator of the right-hand side of equation (70) is positive (only this case satisfies the long-run stability condition when the North exhibits profit-led growth). In this case, an increase in $\bar{z}$ increases the profit share of the North π_N^*, and hence, the capacity utilization rate of the North u_N^* decreases. Since the former positive effect on capital accumulation dominates the latter negative effect on capital accumulation, the economic growth rate of the North g_N^* increases, which leads to profit-led growth. As a result, the growth rate of consumption demand of the North increases, and hence, the growth rate of the value of the North's imports from the South also increases, which increases the long-run terms of trade P^*. Therefore, an increase in the distributive

shift parameter $\bar{z}$ in the long-run equilibrium increases the terms of trade P^{**}, increases the profit share of North π_N^{**}, decreases the capacity utilization rate of the North u_N^{**}, and increases the economic growth rate of the North g_N^{**}. In the same case in the South, capital accumulation accelerates due to the rise of the terms of trade P^{**}, and the growth rate of the South's exports to the North increases because of the increase in the economic growth rate of the North, which consequently increases the economic growth rate of the South g_S^{**}.

We investigate the effect of an increase in the profit share of the South due to an increase in the labor productivity of the South arising from technological progress in the South.

As the comparative static analysis of the short-run equilibrium shows, an increase in the profit share of the South π_S accelerates capital accumulation and has a positive effect on the economic growth rate of the South. However, an increase in the growth rate of the South increases the value of the South's imports from the North and decreases the terms of trade P^*, which has a negative effect on capital accumulation and economic growth in the South. Therefore, the effect of an increase in π_S o economic growth is ambiguous. Meanwhile, in the North, the decrease in the terms of trade P^* decreases the markup rate of the North z, and hence, the profit share of the North decreases. This increase in the wage share increases consumption demand, which increases the capacity utilization rate u_N^*.

Here, we consider the case in which the North exhibits wage-led growth in the short-run equilibrium. The economic growth rate of the North g_N^* increases due to the rise in the wage share, which also increases the growth rate of the North's consumption demand and the South's import demand. As a result, the price of the South goods P^S increases, which increases the terms of trade P^* to some extent. An increase in the profit share of the South π_S has a direct positive effect on capital accumulation in the South. Although this positive effect is offset by the deterioration in the terms of trade to some extent, the deterioration is small because of an increase in the growth rate of consumption demand of the North, and in the end, has a positive effect on capital accumulation in the South. Therefore, in this case, an increase in the profit share of the South π_S in the long-run equilibrium decreases the terms of trade P^{**}, decreases the profit share of the North π_N^{**}, increases the capacity utilization rate of the North u_N^{**}, increases the economic growth rate of the North g_N^{**}, and increases the economic growth rate of the South g_S^{**}.

We consider the case in which the North exhibits profit-led growth in the short-run equilibrium and the denominator of the right-hand side of equation (70) is positive (only this case satisfies the long-run stability condition when the North exhibits profit-led growth.).

In this case, the economic growth rate of North g_N^* decreases because of the decrease in the profit share π_N^*. From this, the growth rate of consumption demand of the North and that of the North's imports from the South also decreases; hence, the terms of trade P^*

decrease in the long run. Therefore, in this case, an increase in the profit share of the South π_S in the long-run equilibrium decreases the terms of trade P^{**}, decreases the profit share of the North π_N^{**}, increases the capacity utilization rate of the North u_N^{**}, and decreases the economic growth rate of the North g_N^{**}. In this case, capital accumulation decelerates due to the deterioration of the terms of trade. Moreover, the decrease of the growth rate of the North decreases the growth rate of the South's exports to the North, which in turn decreases the economic growth rate of the South g_S^{**}.

We conduct a comparative static analysis with respect to the saving rate of the South s_S. Observing equation (60), which determines the long-run equilibrium terms of trade, we find that s_S appears in the same form as π_S, which suggests that an increase in s_S has exactly the same effect as π_S on the long-run equilibrium values. Therefore, we obtain the following results.

First, when the short-run equilibrium exhibits wage-led growth, the results are as follows.

$$s_S \uparrow \Longrightarrow P^{**} \downarrow,\ \pi_N^{**} \downarrow,\ u_N^{**} \uparrow,\ g_N^{**} \uparrow,\ g_S^{**} \uparrow \tag{76}$$

Second, when the short-run equilibrium exhibits profit-led growth, the results are as follows.

$$s_S \uparrow \Longrightarrow P^{**} \downarrow,\ \pi_N^{**} \downarrow,\ u_N^{**} \uparrow,\ g_N^{**} \downarrow,\ g_S^{**} \downarrow \tag{77}$$

The effects of an increase in the saving rate of the South s_S on the long-run equilibrium values can be explained as follows.

An increase in the saving rate of the South s_S accelerates capital accumulation, and hence has a positive effect on the economic growth rate of the North. However, an increase in the growth rate of the South increases the value of the South's imports from the North, and causes the terms of trade P^* to deteriorate, both of which have negative effects on capital accumulation in the South. Therefore, the effect of an increase in the saving rate of the South on the economic growth rate of the South is ambiguous. Meanwhile, in the North, the decrease in the terms of trade P^* decreases the markup rate z, and hence, the profit share of the North π_N^* decreases. Then, the increase in the wage share increases the consumption demand of the North, which increases the capacity utilization rate of the North u_N^*.

With respect to equation (76), when the North exhibits wage-led growth in the short-run equilibrium, an increase in the wage share increases the economic growth rate of the North g_N^*, which increases the growth rate of consumption demand and the growth rate of the North's import demand. However, in the South, although the deterioration of the terms of trade has a negative effect on capital accumulation in the South, an increase in the growth rate

of consumption demand of the North offsets this negative effect, and finally, the economic growth rate of the South increases. Therefore, in this case, an increase in the saving rate of the South s_S decreases the terms of trade P^*, decreases the profit share of the North π_N^{**}, increases the capacity utilization rate of the North u_N^{**}, increases the economic growth rate of the North g_N^{**}, and increases the economic growth rate of the South g_S^{**}.

With respect to equation (77), when the North exhibits profit-led growth and the long-run equilibrium is stable, the economic growth rate of the North g_N^* decreases due to a decrease in π_N^*, which decreases the growth rates of the consumption demand of the North and the North's imports from the South, decreasing the terms of trade P^*. Therefore, in this case, an increase in the saving rate of the South s_S in the long-run equilibrium decreases the terms of trade P^{**}, decreases the profit share of the North π_N^{**}, increases the capacity utilization rate of the North u_N^{**}, and decreases the economic growth rate of the North g_N^{**}. In this case of the South, capital accumulation decelerates due to the deterioration of the terms of trade P^{**}, the growth rate of the South's exports to the North decreases because the economic growth rate of the North decreases, and in the end, the economic growth rate of the South g_S^{**} decreases.

We conduct a comparative static analysis with respect to the saving rate of North s_N.

$$\frac{dP^{**}}{ds_N} = -\frac{\frac{\gamma_1}{s_N(s_N\pi_N-\gamma_1)}}{\frac{\xi}{P^{**}} - \frac{f(\pi_N)\frac{\partial \pi_N}{\partial P}}{\Lambda}} < 0. \tag{78}$$

Using equation (78), we find that an increase in s_N decreases the profit share of the North through a decrease in P^{**}. The effect of an increase in the saving rate of the North on the capacity utilization rate and the economic growth rate of the North can be analyzed in the same way as the comparative static analysis of s_N in the short-run equilibrium. Therefore, an increase in s_N either increases u_N^{**} or decreases. In addition, an increase in s_N the long-run equilibrium g_N^{**} when the short-run equilibrium exhibits profit-led growth, and hence, decreases g_S^{**} through Thirlwall's law. When the short-run equilibrium exhibits wage-led growth, g_S^{**} increases if g_N^{**} increases, while it decreases if g_N^{**} decreases through Thirlwall's law.

$$s_N \uparrow \Longrightarrow P^{**} \downarrow,\ \pi_N^{**} \downarrow,\ u_N^{**} \uparrow \text{ or } \downarrow,\ g_N^{**} \uparrow \text{ or } \downarrow,\ g_S^{**} \uparrow \text{ or } \downarrow \tag{79}$$

The effect of an increase in the saving rate of North s_N on the long-run equilibrium values can be explained as follows.

Similar to the short-run analysis, an increase in the saving rate of North s_N decreases the demand for North consumption, decreases the North's imports from the South, and the terms

of trade P^{**} decreases, which lowers the markup rate of the North, leading to a decrease in the profit share of the North π_N^{**}. If this decrease in π_N^{**} is sufficiently large, the capacity utilization rate of the North u_N^{**} increases although s_N increases because the expenditure share $1 - s_N\pi_N$ increases, and hence, the consumption demand of the North increases. On the contrary, if the decrease in π_N^{**} is sufficiently small, an increase in s_N decreases u_N^{**}.

When the North exhibits profit-led growth in the short-run equilibrium, an increase in the saving rate of the North s_N decreases both the economic growth rates of the North and South. Therefore, in the long run, both countries' growth rates are in equilibrium at a lower level, and hence, both g_N^{**} and g_S^{**} decreases.

When the North exhibits wage-led growth in the short-run equilibrium, an increase in the saving rate of the North s_N increases the economic growth rate of the North g_N^*, while it decreases the economic growth rate of the South g_S^*. If the income elasticity of imports of the North ε_N is sufficiently large, and if the income elasticity of imports of the South ε_S is sufficiently small, then the value of the South's exports to the North increases at a higher rate based on whether the consumption demand of the North increases at a higher rate, and hence, the economic growth rate of the South also increases in the long run. In other words, an increase in s_N increases both g_N^{**} and g_S^{**}. On the contrary, if ε_N is sufficiently small and if ε_S is sufficiently large, the value of the North's exports to the South grows at a lower rate, because the economic growth rate of the South slows down, which in turn decreases the economic growth rate of the North in the long run. Therefore, an increase in s_N increases both g_N^{**} and g_S^{**}.

From the above analysis, the results of the long-run comparative static analysis are summarized in Table 2.

Table 2: Results of comparative statics of the long-run equilibrium

	P^{**}	π_N^{**}	u_N^{**}	g_N^{**}	g_S^{**}
$\bar{z}$	$-^{\dagger}$ $+^{\ddagger}$	$+$	$-$	$-^{\dagger}$ $+^{\ddagger}$	$-^{\dagger}$ $+^{\ddagger}$
π_S	$-$	$-$	$+$	$+^{\dagger}$ $-^{\ddagger}$	$+^{\dagger}$ $-^{\ddagger}$
s_N	$-$	$-$	$+/-$	$+/-^{\dagger}$ $-^{\ddagger}$	$+/-^{\dagger}$ $-^{\ddagger}$
s_S	$-$	$-$	$+$	$+^{\dagger}$ $-^{\ddagger}$	$+^{\dagger}$ $-^{\ddagger}$

† Short-run equilibrium shows a wage-led growth regime.

‡ Short-run equilibrium shows a profit-led growth regime.

From the above analysis, we obtain the following two propositions regarding the rela-

tionship between income distribution and economic growth in the long-run equilibrium.

Proposition 7. *Suppose that the distributive shift parameter of the North increases in the long-run equilibrium. Then, when the short-run equilibrium exhibits wage-led growth, the growth rates of both the North and the South decrease. When the short-run equilibrium exhibits profit-led growth, the growth rates of both the North and the South increase.*

Proposition 8. *Suppose that the profit share of the South increases in the long-run equilibrium. Then, when the short-run equilibrium exhibits wage-led growth, the growth rates of both the North and the South increase. When the short-run equilibrium exhibits profit-led growth, the growth rates of both the North and the South decrease.*

5 Conclusions

In this study, we analyze the effect of an increase in the profit share of the North on the economic growth rates of the North and the South and the effect of an increase in the profit share of the South on the economic growth rates of the North and South in the short-run equilibrium as well as the long-run equilibrium.

From our analyses, we obtain the following policy implications.

If the North exhibits wage-led growth (i.e., if the effect of the profit share of the North on the investment of the North is small), an increase in the profit share by a decrease in the workers' wage bargaining power in the North decreases the capital accumulation rate and the economic growth rate in the North through a decrease in the consumption demand. Moreover, this change decreases the export demand from the South to the North and the terms of trade, and as a result, the rate of capital accumulation also decreases. In other words, when a developed country that exhibits wage-led growth carries out a policy that weakens workers' bargaining power (e.g., deregulation of the labor market), it may cause low growth in both developed and developing countries through the lack of demand.

By contrast, if the North exhibits profit-led growth, an increase in the profit share by a decrease in the workers' wage bargaining power in the North increases the economic growth rate of the North. Moreover, this change increases the economic growth rate of the South through a change in the export demand from the South to the North in the long run. However, even in this case, the economic growth rate of the South decreases with a decrease in the terms of trade in the short run. It must be noted that high growth in developed countries is achieved by forcing low-growth in developing countries temporarily, and that it may cause conflict between the North and the South.

Meanwhile, an increase in the profit share of the South by an increase in labor productivity directly increases the capital accumulation rate of the South. Although this direct effect

is offset by a decrease in the terms of trade through an increase in the import volume from developed countries to some extent, if the developed countries exhibit wage-led growth, then the economic growth rates of both developed and developing countries eventually increase, because this change decreases the profit share and increases the consumption demand and import demand in developed countries. In other words, a policy that promotes the productivity growth of developing countries (e.g., development assistance) has an advantage not only for the developing countries but also for the developed countries.

By contrast, if the North exhibits profit-led growth, a policy that increases the workers' real wage and decreases the profit share in the developing countries (e.g., improvements of labor law) has a positive effect on the economic growth rates of both the developed countries and the developing countries in the long run. Although a decrease in the profit share of the South temporarily decreases the capital accumulation rate of the South, it is likely that the firms in the developed countries are released from the restriction of international price competition and secure sufficient profit owing to an increase in the relative price of goods of the South. As a result, the high growth of the developed countries is achieved, and in turn, the high growth of the developing countries is also achieved.

Appendix: Real wage rate of the North

In this Appendix, we investigate the change in income distribution on the real wage rate of the North. Since workers in the North consume both the North goods and South goods, we define the real wage rate of the North as follows: we divide the nominal wage rate of the North by the consumer price index of the North.

$$V_N = \frac{W_N}{P_S^{\alpha} P_N^{1-\alpha}} = \frac{1}{P^{\alpha}(1+z)b_N} \tag{80}$$

$$= \frac{1-\pi_N}{P^{\alpha} b_N}, \quad \alpha = \alpha_0 (u_N K_N)^{\varepsilon_N - 1} P^{1-\mu_N}. \tag{81}$$

Using equation (81), we investigate the effect of an increase in $\bar{z}$ or the profit share of the South π_S on the real wage rate of the North. We note that these parameters affect π_N, P, and α.

Short-run equilibrium

The effect of an increase in $\bar{z}$ on V_N^* in the short-run equilibrium is given by

$$\frac{d\log V_N^*}{d\bar{z}} = -\frac{1}{1-\pi_N^*}\cdot\frac{d\pi_N^*}{d\bar{z}} - \frac{\alpha^*}{P^*}\left[1+(1-\mu_N)\log P^*\right]\frac{dP^*}{d\bar{z}} - \alpha^*(\varepsilon_N-1)\frac{1}{u_N^*}\cdot\frac{du_N^*}{d\bar{z}}\log P^* \gtreqless 0. \tag{82}$$

Here, we assume that $\varepsilon_N < 1$ and $\mu_N < 1$. The effect of a change in $\bar{z}$ on the real wage rate in the short-run equilibrium can be decomposed into its effect on the profit share of the North, its effect on the terms of trade, and its effect on the North expenditure coefficient on the South goods. In addition, because the logarithm of the terms of trade $\log P^*$ takes either a positive or a negative value based on whether P^* is more than or less than unity, it is difficult to obtain a definite answer.

If the effect of an increase in $\bar{z}$ on α is negligibly small, then equation (82) leads to

$$\frac{d\log V_N^*}{d\bar{z}} = -\frac{1}{1-\pi_N^*}\cdot\frac{d\pi_N^*}{d\bar{z}} - \frac{\alpha^*}{P^*}\cdot\frac{dP^*}{d\bar{z}} \gtreqless 0. \tag{83}$$

From the short-run equilibrium analysis, we know that the effect of an increase in $\bar{z}$ on the profit share of the North is positive, and its effect on the terms of trade is negative. If the former positive profit-share effect dominates the latter negative terms-of-trade effect, then an increase in the distributive shift parameter of the North decreases the real wage rate of the North. On the contrary, if the latter negative terms of trade dominate the former positive profit-share effect, then an increase in the distributive shift parameter of the North increases the real wage rate of the North.

The implications for the results given by equation (83) are as follows.

When the relative bargaining power of workers in the North decreases, firms in the North raise the markup rate to maintain their profits, and hence, the price of North goods P_N^* increases. This puts downward pressure on the real wage rate of the North V_N^*. Meanwhile, since an increase in P_N^* means a decrease in the terms of trade P^*, the real price of import goods from the South decreases, which puts upward pressure on V_N^*. Therefore, if the expenditure share of import goods for domestic consumption is sufficiently small, an increase in the domestic price leads to a stronger effect than a decrease in the import price does, and hence, the real wage rate of the North V_N^* decreases. On the contrary, if the expenditure share of import goods for domestic consumption is sufficiently large, the real wage rate of the North V_N^* increases.

The effect of an increase in the profit share of the South on the real wage rate of the

North is given by

$$\frac{d\log V_N^*}{d\pi_S} = -\frac{1}{1-\pi_N^*}\cdot\frac{d\pi_N^*}{d\pi_S} - \frac{\alpha^*}{P^*}\cdot\frac{dP^*}{d\pi_S} > 0. \tag{84}$$

From the short-run equilibrium analysis, the effect of an increase in the profit share of the South on the profit share of the North is negative, and its effect on the terms of trade is negative. Therefore, an increase in the profit share of the South increases the real wage rate of the North.

The implications for the results given by equation (84) are as follows.

When technological progress increases the labor productivity of the South, and hence, the profit share of the South π_S increases, capital accumulation in the South accelerates; hence, the value of the South's imports from the North increases, which decreases the terms of trade P^*. For workers in the North, this means a decrease in the real price of import goods from the South. In addition, firms in the North decrease the markup rate according to the decrease in the terms of trade P^*, and the domestic price of the North goods P_N^* also decreases. Therefore, since the price of North goods and that of South goods decrease, the real wage rate of the North necessarily increases.

Long-run equilibirum

In the long run, as long as $\varepsilon_N < 1$, the expenditure coefficient α approaches zero based on whether K_N increases. As a result, since the terms-of-trade effect and the expenditure share effect vanish, the effect of an increase in $\bar{z}$ on the long-run equilibrium real wage rate of the North is given by

$$\frac{d\log V_N^{**}}{d\bar{z}} = -\frac{1}{1-\pi_N^{**}}\cdot\frac{d\pi_N^{**}}{d\bar{z}} < 0. \tag{85}$$

Therefore, an increase in $\bar{z}$ decreases the real wage rate of the North.

In the long run, as the North grows, the North expenditure share of import goods for domestic consumption decreases. For this reason, even if an increase in $\bar{z}$ increases the real wage rate of the North V_N^*, the effect of the decrease in the real price of import goods from the South vanishes, and hence, only the effect of the increase in the domestic price prevails. Therefore, an increase in $\bar{z}$ due to the decrease in the relative bargaining power of workers necessarily decreases the long-run equilibrium real wage rate of the North V_N^{**}.

The effect of an increase in the profit share of the South π_S on the real wage rate of the

North is given by

$$\frac{d \log V_N^{**}}{d\pi_S} = -\frac{1}{1-\pi_N^{**}} \cdot \frac{d\pi_N^{**}}{d\pi_S} > 0. \tag{86}$$

Therefore, an increase in the profit share of the South increases the real wage rate of the North.

An increase in the profit share of the South π_S decreases both the terms of trade P^{**} and the profit share of the North π_N^{**} in the long run. As a result, since the domestic price of the North goods P_N^{**} decreases, the real wage rate of the North V_N^{**} necessarily increases.

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